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Ergonomic risk factors for the wrists of hairdressers

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ABSTRACT

This study utilized a portable data logger to measure the wrist angles and forearm flexor and extensor electromyography (EMG) of 21 hairstylists. The hairstylists were divided into two groups, one with 11 barbers (9 males and 2 females) specializing in men's hairdressing, and one with 10 hairdressers (2 males and 8 females) specializing in women's hairdressing. The standard haircut task was divided into three subtasks: hair cutting, washing and blow-drying. The mechanical exposures of the overall task and subtasks were quantified to compare how subtasks, occupational groups, and gender groups differ. Experimental results show that the average time to finish a woman's haircut (51.4 min) is significantly longer than that for a man's haircut (35.6 min) ($p < 0.005$). Female hairstylists had significantly greater EMG activity than male hairstylists did ($p < 0.001$). The non-dominant hands of hairdressers have significantly higher overall wrist velocity than those of barbers ($p < 0.005$). Analytical results suggest that the relatively higher force exertion and wrist velocity of female hairstylists combined with prolonged exposure may account for the higher rate of hand/wrist pain in female hairdressers than in male barbers.
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1. Introduction

Musculoskeletal discomfort, pain or injury among hairdressers and barbers is common and results in reduced job performance and productivity, increased time off work, and even early retirement (New Zealand DOL, 2007). Following asthma and hand eczema, musculoskeletal disorders are the primary cause of premature departure from the hairdresser profession in Finland (Leino et al., 1999). In the US, hairdressing is a high-risk occupation associated with back pain that results in morbidity and reduced production (Guo et al., 1995). English et al. (1995) examined 221 UK females with upper-limb soft-tissue disorders seeking treatment at orthopedic clinics and identified that hairdressers have significantly more shoulder and ganglia injuries than other occupations. Kang et al. (1999) evaluated work-related symptom prevalence among hairdressers. The exposed group comprised 184 hair salon employees in 6 districts of Pusan city, and non-exposed group comprised 119 people living in the same areas. They reported the prevalence of musculoskeletal symptoms among Korean hairdressers was neck (59.9%) shoulder (76.6%), upper back (41.2%), lower back (72.2%), arm and elbow (31.3%), wrist (44.2%), finger (35.0%), leg (71.1%). The highest age-adjusted odd ratio (4.83) for exposed group compare to non-exposed group was for fingers.

According to data from Taiwan's Bureau of Labor Statistics, more than 50,000 workers were employed at salons or barbershops as hairdressers and barbers (Taiwan DGBAS, 2001). Although the total number of hairstylists is limited compare to other industry populations, the hairdressing industry accounted for approximately 24% of compensation cases for work-related hand-wrist morbidity between Jan 2003 and June 2006 (Taiwan IOSH, 2006). Furthermore, the number of such insurance claims has increased annually since 1998, with most musculoskeletal disorder cases from professions associated with women's hairdressing. A previous study (Taiwan IOSH, 2004), which analyzed compensation cases in 2001–2003 in the database generated by the Council of Labor Affairs, found that 260 new work-related cases were for hand-arm or neck-shoulder disorders. Among these cases, 22 cases (20 for females and 2 for males) were hairstylists.

Undesirable postures and movements in activities such as hair cutting, combing, washing, and blow-drying must be eliminated to minimize risk of injury among hairdressers (New Zealand DOL, 2007). Few studies have focused on neck/shoulder problems of hairdressers (Hagberg, 1984; Nevala-Puranen et al., 1998). Arokoski et al. (1998) performed an intervention on 21 female hairdressers with neck/shoulder or back pain. After approximately 4 weeks of rehabilitation and vocational courses during 1 year, a positive outcome was achieved; that is, physical strain and pain symptoms were reduced. Veiersted et al. (2008) quantitatively analyzed the biomechanical workload of the neck and shoulder region of female hairdressers before and after an intervention. Their study showed

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that hairdressers typically worked with their arms elevated at $\geq 60^{\circ}$ for approximately 13% of total work time. Although strain injuries to wrists or elbows are major reasons why hairdressers leave the profession (Leino et al., 1999), knowledge regarding the mechanical exposures of hairdressers' remains limited.

This study assesses and compares the mechanical exposure of the wrists of barbers and hairdresser while performing regular haircutting tasks.

2. Method

2.1. Subjects

Eleven barbers (9 males and 2 females) who specialized in men's hairdressing, and 10 hairdressers (2 males and 8 females) who specialized in women's hairdressing, were recruited from 2 barbershops and 3 hair salons in Taichung City, Taiwan. The sample size from each salon or barbershop was roughly 50–60% of the working population in the salons and barbershops. All subjects possessed professional certificates, a minimum of five years of experience, and less than two weeks sick leave due to musculoskeletal pain associated with any body part during the previous 12 months.

Personal data of subjects, such as age, stature, experience, clinical records, work information, and discomfort in the musculoskeletal system, were collected by an experimenter who interviewed individual subjects. The age and years of experience was not significantly different between barbers (age, 31.7 ± 2.4 yrs; experience, 13.2 ± 3.7 yrs) and hairdressers (age, 28.4 ± 4.4 yrs; experience, 10.5 ± 5.3 yrs). However, barbers (height, 167.1 ± 5.6 cm; weight, 63.2 ± 8.8 kg) were significantly taller and heavier than the hairdressers (height, 160.3 ± 4.1 cm; weight, 52.7 ± 4.3 kg) ($p < 0.01$, t-test). All subjects were right-handed and worked approximately 12 h a day, 6 days a week. A barber on average handled 7–8 cases (customers) per day; each standard haircut took roughly 35 min. Periods between customers were rest periods. A hairdresser on average handled 6–7 customers per day; each standard haircut took approximately 50 min. The most common tasks during haircuts were hair cutting, washing and blow-drying.

Among the barbers, only 1 complained about wrist pain and the others had only experienced minor soreness in the neck, shoulders, lower back, and lower legs due to working for extended periods. No barber had sought rehabilitation therapy or any alternative medical treatments for persistent pain. However, 50% of the hairdressers experienced pain in their dominant hand and/or wrist, and 30% of the hairdressers experienced pain in their non-dominant hand and/or wrist. About 50% of hairdressers have sought rehabilitation therapy or a particular Chinese medical treatment (acupuncture or naprapathy) for pain relief.

2.2. Experimental procedures

To assess mechanical exposure associated with posture, forceful exertion and repetitive motion of hands, a data logger (Liu et al., 2006) and camcorder were synchronized to record the haircut process. Two biaxial goniometers (SX65, BioMetrics Ltd., UK) were employed to measure right and left dorsal-palmer flexion and radial–ulnar deviation of wrist angles. The goniometers were encased in saran wrap to prevent them from getting wet during hair washing. Four EMG electrodes with 20 mm intra-distance bipolar surface electrodes (SX230, BioMetrics Ltd., UK; gain: 1000; band-pass: 20–450 Hz; input impedance $>10^{12}\,\Omega$) were placed over the right and left flexor digitorum superficialis and extensor digitorum comunis of subjects to record relevant muscular activities. These muscles were chosen for their relevance when performing tasks, such as grasping a tool, cutting and washing hair, and for the ability of researchers to position surface electrodes over muscle bellies. Before electrodes were placed, skin was cleaned with acetone and rubbed gently with fine abrasive paper. Each bipolar surface electrode was placed along the muscle with the electrode center at the point of recommended insertion of needle electrode (Delagi et al., 1994). Fig. 1 shows the experimental setup for a barber cutting hair.

Subjects were interviewed before calibration thereby providing about 10 min for stabilizing EMG electrode impedance. The resting EMGs of each subject were recorded for 30 s immediately after the interview while subject relaxed and stood with arms hanging down. A series of calibrations were then conducted to obtain an individual reference for wrist angle and maximal voluntary capacity of each muscle. Angular measurements were calibrated in relation to individual maximal voluntary flexion–extension and radial–ulnar deviation of the wrist. All maximal voluntary contractions were performed for both arms while standing in order of right extensor, right flexor, left extensor, and left flexor. A 5-sec maximal voluntary muscle contraction on each muscle group was measured with 2-minute rest between each maximum attempt. To test maximal voluntary contractions of the wrist flexor/extensor muscles, subjects were asked to flex/extend their wrists maximally against an external load applied to their wrist and forearm while the elbow was at 90° flexion. The recorded EMG signals were later utilized to normalize the EMG signals recorded during task performance by expressing these signals as a percentage of

Fig. 1. Experiment setup of a barber cutting hair.

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